CERTIFICATE OF DEPOSIT
I hereby certify that this paper and every paper referred to therein as being enclosed is being electronically deposited with the USPTO via the USPTO eFiling portal.

on May 29, 2008 (Date of Deposit – U.S. Pacific Standard Time (PST))

Mark A. Watson Mark Watson
By Signature

Application No.	**:**	**10/772,528**
Confirmation No.	**:**	**5405**
Applicant	**:**	**MALVAR, et al.**
Title	**:**	**ANALOG PREAMPLIFIER MEASUREMENT FOR A MICROPHONE ARRAY**
Filed	**:**	**February 4, 2004**
TC/A.U.	**:**	**2615**
Examiner	**:**	**LEE, Ping**
Docket No.	**:**	**MCS-070-03 (307216.01)**
Customer No.	**:**	**27662**

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF

I. REAL PARTY IN INTEREST

The subject application is assigned to Microsoft Corporation, of Redmond Washington.

II. RELATED APPEALS AND INTERFERENCES

There are no known related appeals or interferences.

III. STATUS OF CLAIMS

1. Claims 1 through 20 represent all claims currently pending in the application.

2. Claims 1 through 20 are rejected.

3. The rejection of claims 1 through 20 is hereby appealed.

IV. STATUS OF AMENDMENTS

No amendments are currently pending.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

The pending patent application includes three independent claims: claims 1, 9, and 15. A summary of the subject matter claimed in each independent claim is provided below, with reference to specific page and line number of the specification and reference to specific elements of the drawings, as necessary.

a. Subject Matter of Independent Claim 1:

In general, the subject matter of claim 1 relates to a system for computing frequency domain compensation gains for use in "***automatically matching***

preamplifiers in a microphone array." Matching of preamplifiers is generally accomplished by injecting an "excitation pulse" directly into each pre-amplifier, measuring the responses of each pre-amplifier, analyzing the measured responses, and using that analysis for computing compensation gains used to match an output of each preamplifier.

For example, FIG. 5 of the present application, as described in paragraphs [0098] through [0103] on pages 9-10 of United States Patent Application Publication 20050169483 A1, shows that a "preamplifier pulse test circuit" generates and injects an excitation pulse of known magnitude and phase into each preamplifier (510). Note that one example of the preamplifier pulse test circuit is illustrated as element 720 of FIG. 7, which shows that an output of the preamplifier pulse test circuit is tied to an input of the preamplifier 710.

Referring back to FIG. 5, once the excitation pulse is injected (510) into each of the preamplifiers in the microphone array, the output/response of each preamplifier to the excitation pulse is then measured (520). Next, a frequency analysis of the preamplifier output resulting from the excitation pulse is performed (530) to compute magnitude, frequency and phase information for the resulting preamplifier output.

This information resulting from this frequency analysis is then used to compute a set of frequency domain compensation gains (540) for each preamplifier. In particular, given the frequency-domain response of each preamplifier determined by the frequency analysis (530), the claimed system computes frequency-domain magnitude and phase gains (540) for each individual preamplifier. As claimed, these frequency-domain compensation gains are used for matching the output of each preamplifier. In other words, the magnitude frequency-domain response (i.e., the "outputs") of each preamplifier are matched using the compensation gains computed for each individual preamplifier.

In view of the preceding discussion, and in further view of FIG. 5 in combination with the circuit diagram of FIG. 7, is should be clear that any microphones in the microphone array are not considered when computing the claimed frequency-domain compensation gains. Furthermore, it should also be clear that since there is no consideration of any microphones in the microphone array when computing the claimed frequency-domain compensation gains, that the claimed frequency-domain compensation gains will ***not*** serve to match each complete channel (i.e., each microphone/preamplifier combination) of the microphone array. In other words, it is important to note that the claimed system specifically matches the individual preamplifiers in the microphone array rather than matching the individual channels in the microphone array.

b. Subject Matter of Independent Claim 9:

In general, the subject matter of claim 9 relates to a method for "automatically ***matching preamplifier frequency-domain responses in a microphone array***" by computing frequency domain compensation gains for use in matching separate pre-amplifiers in a microphone array. Matching of preamplifier frequency-domain responses is generally accomplished by generating and injecting an "excitation pulse" directly into each pre-amplifier, measuring the responses of each pre-amplifier, analyzing the measured responses, and using that analysis for computing compensation gains used to match an output of each preamplifier.

For example, FIG. 5 of the present application, as described in paragraphs [0098] through [0103] on pages 9-10 of United States Patent Application Publication 20050169483 A1, shows that a "preamplifier pulse test circuit" generates and injects at least one excitation pulse having a predetermined phase, magnitude and duration into each preamplifier (510). Note that one example of the preamplifier pulse test circuit is illustrated as element 720 of FIG. 7, which shows that an output of the preamplifier pulse test circuit is tied to an input of the preamplifier 710.

Referring back to FIG. 5, once the excitation pulse is injected (510) into each of the preamplifiers in the microphone array, the output/response of each preamplifier to the excitation pulse is then measured (520). This output is then digitized and a frequency analysis of the digitized preamplifier output is performed (530) to compute magnitude, frequency and phase information for the resulting preamplifier output.

The information resulting from this frequency analysis (530) is then used to "compute ***frequency-domain compensation gains from the results of the frequency-domain analysis for matching the output of each preamplifier*** in the microphone array with each other" (540). In particular, given the frequency-domain response of each preamplifier determined by the frequency analysis (530), the claimed method computes frequency-domain magnitude and phase gains (540) for each individual preamplifier. As claimed, these frequency-domain compensation gains are used for matching the output of each preamplifier. In other words, the magnitude frequency-domain response (i.e., the "outputs") of each preamplifier are matched using the compensation gains computed for each individual preamplifier.

In view of the preceding discussion, and in further view of FIG. 5 in combination with the circuit diagram of FIG. 7, is should be clear that any microphones in the microphone array are not considered when computing the claimed frequency-domain compensation gains. Furthermore, it should also be clear that since there is no consideration of any microphones in the microphone array when computing the claimed frequency-domain compensation gains, the claimed frequency-domain compensation gains will ***not*** serve to match each complete channel (i.e., each microphone/preamplifier combination) of the microphone array. In other words, it is important to note that the claimed method specifically matches each preamplifier in the microphone array with the other preamplifiers rather than matching the individual channels in the microphone array.

c. <u>Subject Matter of Independent Claim 15:</u>

In general, the subject matter of claim 15 relates to a system for "automatically ***calibrating preamplifiers in a microphone array to provide matched preamplifier outputs***" computing frequency domain compensation gains for use in matching separate pre-amplifiers in a microphone array. Matching of preamplifier frequency-domain responses is generally accomplished by generating and injecting an "excitation pulse" directly into each pre-amplifier, measuring the responses of each pre-amplifier, analyzing the measured responses, and using that analysis for computing compensation gains used to match an output of each preamplifier.

As illustrated by FIG. 7, an output of a "switchable pulse generation circuit" (see the preamplifier pulse test circuit (720)) is tied to an input of each preamplifier. This switchable pulse generation circuit is triggered by "remotely initiating generation of at least one excitation pulse in the switchable pulse generation circuit from a remote computing device coupled to the microphone array via a computer interface." Specifically, as discussed in paragraph [0113], an input at point A (750) is used to trigger the claimed switchable pulse generation circuit to generate the excitation pulse. As noted above, the output of the pulse generation circuit 720 is tied to an input of each preamplifier 710. Consequently, when the pulse generation circuit 720 generates the excitation pulse, the claimed system automatically injects "***each excitation pulses into each preamplifier***."

For example, FIG. 5 of the present application, as described in paragraphs [0098] through [0103] on pages 9-10 of United States Patent Application Publication 20050169483 A1, shows that a switchable "preamplifier pulse test circuit" generates and injects at least one excitation pulse having a predetermined phase, magnitude and duration into each preamplifier (510). Then, once the excitation pulse is injected (510) into each of the preamplifiers in the microphone array, the output/response of each preamplifier to the excitation pulse is then measured (520) and provided to the remote computing device. The remote computing device then performs a frequency analysis of

the preamplifier output (530) to compute magnitude, frequency and phase information for the resulting preamplifier output.

Finally, the information resulting from this frequency analysis (530) is then used for "***computing frequency-domain compensation gains from the results of the frequency-domain analysis for matching the output of each preamplifier*** in the microphone array with each other" (540). In particular, given the frequency-domain response of each preamplifier determined by the frequency analysis (530), the claimed system uses the remote computing device to compute frequency-domain magnitude and phase gains (540) for each individual preamplifier. As claimed, these frequency-domain compensation gains are used for matching the output of each preamplifier. In other words, the magnitude frequency-domain response (i.e., the "outputs") of each preamplifier are matched using the compensation gains computed for each individual preamplifier.

In view of the preceding discussion, and in further view of FIG. 5 in combination with the circuit diagram of FIG. 7, is should be clear that any microphones in the microphone array are not considered when computing the claimed frequency-domain compensation gains. Furthermore, it should also be clear that since there is no consideration of any microphones in the microphone array when computing the claimed frequency-domain compensation gains, the claimed frequency-domain compensation gains will ***not*** serve to match each complete channel (i.e., each microphone/preamplifier combination) of the microphone array. In other words, it is important to note that the claimed system specifically matches each preamplifier in the microphone array with the other preamplifiers rather than matching the individual channels in the microphone array.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

a. Independent claim 1 stands rejected under 35 U.S.C. §103(a) as being unpatentable over ***Heeden*** (U.S. Patent 5,125,260) in view of ***Miller*** (U.S. Patent 5,029,215).

b. Independent claim 9 stands rejected under 35 U.S.C. §103(a) as being unpatentable over ***Heeden*** in view of ***Miller***.

c. Independent claim 15 stands rejected under 35 U.S.C. §103(a) as being unpatentable over ***Heeden*** in view of ***Miller***.

VII. ARGUMENT

a. Rejection of Claim 1 under 35 U.S.C. §103(a):

In the Final Office Action dated December 11, 2007, independent claim 1 was rejected under 35 U.S.C. §103(a) as being unpatentable over ***Heeden*** (U.S. Patent 5,125,260) in view of ***Miller*** (U.S. Patent 5,029,215). In general, the Examiner rejected independent claim 1 under 35 U.S.C. §103(a) based on the rationale that the proposed ***Heeden*** – ***Miller*** combination reference discloses the Appellants' claimed "…system for automatically matching preamplifiers in a microphone array…"

However, in view of the following discussion, Appellants' respectively suggest that independent claim 1 is patentably distinct from the cited references, and from any combination thereof, and therefore respectfully traverse the rejection of claim 1, and the claims dependent therefrom, under 35 U.S.C. §103(a). Further, in view of the "***Response to Arguments***" presented on pages 4-6 of the final Office Action, the Appellants respectfully suggest that the Examiner has mischaracterized the claimed system and the purpose therefor.

For example, on page 6 of the Final Office Action, the Examiner specifically states:

> "The current invention as claimed ***does not simply match preamplifier as alleged*** in the argument (p. 12), the actual function is match output characteristic from the preamplifier coupled to a microphone… ***There is no point of matching the preamplifiers if they are not coupled to microphones***. It is clear based on the specification and the body of the claims that the current invention matching the output of a preamplifier coupled to a microphone with another preamplifier coupled to another microphone…" (emphasis added)

In making the above quoted statement, it appears to Appellants that the Examiner fails completely to understand the primary purpose of the claimed system. First, the claimed system ***does match preamplifiers as alleged***. Specifically, given a microphone array, the preamplifiers in that array can be closely matched ***without considering the microphones coupled to those preamplifiers by using synthetic excitation pulses injected directly into the preamplifiers***. This point is clearly described throughout the specification. Further, as described in further detail below, this point is fully supported by the figures and the claims. In addition, specific advantages of matching the preamplifiers without considering the microphones are explained in paragraphs [0016] and [0017] of the specification, as follows:

> "[0016] Once computed, these frequency-domain compensation gains can then be applied to the output of each corresponding preamplifier when processing actual audio inputs of the microphones associated with each preamplifier. ***This serves to make the output from each of the preamplifiers consistent, given the same or similar input to any of the microphones in the array***. Consequently, using these computed frequency-domain compensation gains, audio processing software such as, for example, software for performing sound source localization, beam forming, acoustic echo cancellation, noise suppression, etc., can easily compensate for phase response mismatches across

all preamplifiers. Without this compensation, any phase response mismatches would reduce the performance of the audio processing software."

"[0017] Therefore, ***as a result of computing and providing these frequency-domain compensation gains for each preamplifier, there is no need to use expensive matched electrical components***. Consequently, one advantage offered by the integral self-calibration system described herein is that microphone arrays using this integral self-calibration system may be inexpensively produced by using relatively inexpensive non-matched electrical components including, for example, transistors, capacitors, resistors, op amps, etc."

As discussed in further detail below, both the ***Heeden*** and ***Miller*** references describe various techniques computing gains for the ***combination*** of a microphone and preamplifier based on preamplifier outputs resulting from ***inputs to the microphone that are then passed from the microphone to the preamplifier***.

Unfortunately, it appears that the Examiner has mistakenly equated the fact that the claimed preamplifiers are ***merely coupled to microphones*** in the microphone array with the fact that the preamplifiers in the both the ***Heeden*** and ***Miller*** references ***are a necessary and integral part*** of the gain compensation techniques described by ***Heeden*** and ***Miller*** for specifically matching ***microphone/preamplifier combinations***.

In fact, in contrast to the teaching of both ***Heeden*** and ***Miller***, and as explained in the Appellants prior response, the claimed system does ***not*** use microphone inputs to compute compensation gains, and the claimed system does ***not*** use computed compensation gains to match microphone/preamplifier ***combinations***. In fact, as discussed in further detail below, the Applicants specifically claim generating and injecting a synthetic "excitation pulse" directly into the preamplifiers, with the preamplifier output resulting from that synthetic "excitation pulse" being used to match the preamplifiers in the microphone array. Again, it must be noted that ***microphone inputs are not a factor in determining the claimed compensation gains***, and that

the claimed system is ***not*** intended to match microphone/preamplifier ***combinations*** as is taught by both ***Heeden*** and ***Miller***.

In other words, while both ***Heeden*** and ***Miller*** specifically ***require microphone inputs*** that are then provided to the preamplifier, Appellants specifically describe and claim a synthetic "excitation pulse" that is injected directly into the preamplifiers (thus inherently ***bypassing*** the microphones coupled to those preamplifiers). As such, the proposed ***Heeden*** – ***Miller*** combination reference fails to disclose the claimed system.

In particular, in the Final Office Action, the Examiner suggested that the ***Heeden*** reference discloses the claimed system with the exception of a "preamplifier coupled to each microphone in the microphone arrays." The Examiner then continues by suggesting that the use of preamplifiers is disclosed by the ***Miller*** reference, with the combination of ***Heeden*** and ***Miller*** disclosing the claimed system. However, Appellants respectfully suggest that in making the aforementioned arguments, the Examiner has incorrectly characterized the claimed system.

For example, it should be noted that in describing the language of the Appellants' claimed system, the Examiner first states that "Heeden discloses a system ***for automatically matching <u>responses</u>*** in a microphone array…" (emphasis added). However, the language of the claimed system specifically recites a "system for ***automatically <u>matching preamplifiers</u> in a microphone array***." In claim 1, Appellants do not suggest or claim that any microphones in the microphone array are in any way used or addressed when matching the preamplifiers in that array. See for example FIG. 7 which shows the preamplifier pulse test circuit 720 ***tied directly to the input of the preamplifier*** 710 for injecting excitation pulses directly into the preamplifier.

On the other hand, ***Heeden*** discloses the adjustment of ***channel sensitivities*** of pressure transducing ***<u>microphones</u> over a range of frequencies*** for <u>matching an independently calibrated ***microphone*** to a second microphone</u> (see, for example, the

Abstract and column 4, lines 39-66 of the ***Heeden*** reference). In other words, ***Heeden*** requires that at least one microphone is first ***independently calibrated***. All other microphones are then matched to the independently calibrated microphone. Clearly, such teachings fail completely to disclose injection of "excitation pulses" directly into preamplifiers for the purpose of computing compensation gains to match each of the preamplifiers to each other ***regardless*** of microphone characteristics.

With respect to the ***Miller*** reference, the Examiner suggests that ***Miller*** teaches "…having preamplifiers (410, 411) coupled to each microphone…" The Examiner then continues by ***admitting*** that "the gains of the preamplifiers are adjusted to match the frequency responses <u>***between the microphones in the microphone array***</u>." (emphasis added). Finally, the Examiner concludes in the rejection of claim 1 by suggesting that "…it would have been obvious… to modify Heeden in view of Miller by utilizing the adjustable preamplifier coupled to each microphone… in order to adjust the gain after frequency analysis." However, in contrast to the position advanced by the Examiner, Appellants respectfully suggest that the proposed ***Heeden*** – ***Miller*** combination reference fails to disclose the elements suggested by the Examiner.

For example, as clearly explained by the Examiner, ***Miller*** operates by adjusting "the gains of the preamplifiers… to match the frequency responses <u>***between the microphones in the microphone array***</u>" (emphasis added). Appellants agree that ***Miller*** operates by adjusting "the gains of the preamplifiers… to match the frequency responses between the microphones in the microphone array." In fact, this process is clearly illustrated by FIG. 4 of the ***Miller*** reference which shows a transducer (203) producing a sound signal that is captured by two microphones (201 and 202) that each then send the captured sound to an associated preamplifier (410 and 411, respectively). As noted by the Examiner, ***Miller*** then adjusts the preamplifier gain to ***match the frequency response between the microphones***.

In other words, ***Heeden*** discloses the adjustment of <u>***channel sensitivities***</u> of pressure transducing <u>***microphones***</u> ***over a range of frequencies*** for matching an

independently calibrated ***microphone*** to a second microphone, while ***Miller*** discloses adjusting preamplifier gains to ***match the frequency response between microphones***. Consequently, since both ***Heeden*** and ***Miller*** act separately to match microphone responses, Appellants respectfully suggest that the proposed ***Heeden-Miller*** combination reference must also act to ***match microphone responses based on inputs to those microphones***.

However, as noted above, Appellants neither describe nor claim matching ***channel sensitivities*** of pressure transducing ***microphones***. Further, Appellants neither describe nor claim matching ***the frequency response between microphones***. In fact, Appellants are not evaluating or matching the response of any microphones in the microphones array. Instead, Appellants are directly matching the response of preamplifiers based on a frequency-domain analysis of the measured preamplifier output response to synthetic excitation pulses that completely bypass the microphones, and computing frequency-domain compensation gains for use in matching the output of the preamplifiers.

In other words, the proposed ***Heeden*** – ***Miller*** combination reference matches a ***microphone/preamplifier combination*** based on ***inputs to the microphones*** relative to an independently calibrated microphone while the claimed system operates to match ***preamplifiers*** using a synthetic excitation pulse injected directly into the preamplifiers independent from the microphones to which those preamplifiers are coupled.

Therefore, in stark contrast to the position advanced by the Examiner, it should be clear that the proposed ***Heeden*** – ***Miller*** combination reference fails completely to disclose the Appellants' claimed system. Consequently, with respect to claim 1, no prima facie case of obviousness has been established in accordance with both the M.P.E.P. Section 706.02(j), and in accordance with the holdings of *In Re Fine*. This lack of a prima facie showing of obviousness means that the rejected claims are patentable under 35 U.S.C. §103(a). Therefore, the Appellants respectfully traverse the rejection of claim 1, and thus request reconsideration of the rejection of claim 1, and of

the claims dependent therefrom, under 35 U.S.C. §103(a) over the proposed ***Heeden-Miller*** combination reference in view of the novel language of claim 1, as recited below:

> "A system for ***automatically <u>matching preamplifiers</u> in a microphone array***, comprising:
>
> ***injecting at least one excitation pulse <u>into each preamplifier</u>*** in the microphone array;
>
> ***measuring each preamplifier output response*** to each excitation pulse;
>
> performing a frequency-domain ***analysis of the measured preamplifier output response to each excitation pulse***; and
>
> ***computing frequency-domain compensation gains from the results of the frequency-domain analysis for matching the output of each preamplifier***." (emphasis added)

b. <u>Rejection of Claim 9 under 35 U.S.C. §103(a):</u>

In the Final Office Action dated December 11, 2007, independent claim 9 was rejected under 35 U.S.C. §103(a) as being unpatentable over ***Heeden*** (U.S. Patent 5,125,260) in view of ***Miller*** (U.S. Patent 5,029,215). In general, the Examiner rejected independent claim 9 under 35 U.S.C. §103(a) based on the rationale that the proposed ***Heeden*** – ***Miller*** combination reference discloses the Appellants' claimed method for "…automatically ***matching preamplifier frequency-domain responses*** in a microphone array …"

However, in view of the following discussion, Appellants' respectively suggest that independent claim 9 is patentably distinct from the cited references, and from any combination thereof, and therefore respectfully traverse the rejection of claim 9, and the claims dependent therefrom, under 35 U.S.C. §103(a). Further, in view of the "***Response to Arguments***" presented on pages 4-6 of the final Office Action, the Appellants respectfully suggest that the Examiner has mischaracterized the claimed method and the purpose therefor.

For example, on page 6 of the Final Office Action, the Examiner specifically states:

> "The current invention as claimed ***does not simply match preamplifier as alleged*** in the argument (p. 12), the actual function is match output characteristic from the preamplifier coupled to a microphone… ***There is no point of matching the preamplifiers if they are not coupled to microphones***. It is clear based on the specification and the body of the claims that the current invention matching the output of a preamplifier coupled to a microphone with another preamplifier coupled to another microphone…" (emphasis added)

In making the above quoted statement, it appears to Appellants that the Examiner fails completely to understand the primary purpose of the claimed method. First, the claimed method ***does specifically match preamplifiers as alleged***. In particular, given a microphone array, the preamplifiers in that array can be closely matched ***without considering the microphones coupled to those preamplifiers by using synthetic excitation pulses injected directly into the preamplifiers***. This point is clearly described throughout the specification. Further, as described in further detail below, this point is fully supported by the figures and the claims. In addition, specific advantages of matching the preamplifiers without considering the microphones are explained in paragraphs [0016] and [0017] of the specification, as follows:

> "[0016] Once computed, these frequency-domain compensation gains can then be applied to the output of each corresponding preamplifier when processing actual audio inputs of the microphones associated with each preamplifier. ***This serves to make the output from each of the preamplifiers consistent, given the same or similar input to any of the microphones in the array***. Consequently, using these computed frequency-domain compensation gains, audio processing software such as, for example, software for performing sound source localization, beam forming, acoustic echo cancellation, noise suppression, etc., can easily compensate for phase response mismatches across

all preamplifiers. Without this compensation, any phase response mismatches would reduce the performance of the audio processing software."

"[0017] Therefore, ***as a result of computing and providing these frequency-domain compensation gains for each preamplifier, there is no need to use expensive matched electrical components***. Consequently, one advantage offered by the integral self-calibration system described herein is that microphone arrays using this integral self-calibration system may be inexpensively produced by using relatively inexpensive non-matched electrical components including, for example, transistors, capacitors, resistors, op amps, etc."

As discussed in further detail below, both the ***Heeden*** and ***Miller*** references describe various techniques computing gains for the ***combination*** of a microphone and preamplifier based on preamplifier outputs resulting from ***inputs to the microphone that are then passed from the microphone to the preamplifier***.

Unfortunately, it appears that the Examiner has mistakenly equated the fact that the claimed preamplifiers are ***merely coupled to microphones*** in the microphone array with the fact that the preamplifiers in the both the ***Heeden*** and ***Miller*** references ***are a necessary and integral part*** of the gain compensation techniques described by ***Heeden*** and ***Miller*** for specifically matching ***<u>microphone/preamplifier combinations</u>***.

In fact, in contrast to the teaching of both ***Heeden*** and ***Miller***, and as explained in the Appellants prior response, the claimed method does ***not*** use microphone inputs to compute compensation gains, and the claimed method does ***not*** use computed compensation gains to match microphone/preamplifier ***combinations***. In fact, as discussed in further detail below, the Applicants specifically claim generating and injecting a synthetic "excitation pulse" directly into the preamplifiers, with the preamplifier output resulting from that synthetic "excitation pulse" being used to match the preamplifiers in the microphone array. Again, it must be noted that ***<u>microphone inputs are not a factor in determining the claimed compensation gains</u>***, and that

the claimed method is ***not*** intended to match microphone/preamplifier ***combinations*** as is taught by both ***Heeden*** and ***Miller***.

In other words, while both ***Heeden*** and ***Miller*** specifically ***require microphone inputs*** that are then provided to the preamplifier, Appellants specifically describe and claim a synthetic "excitation pulse" that is injected directly into the preamplifiers (thus inherently ***bypassing*** the microphones coupled to those preamplifiers). As such, the proposed ***Heeden*** – ***Miller*** combination reference fails to disclose the claimed method.

In particular, in the Final Office Action, the Examiner suggested that the ***Heeden*** reference discloses the claimed method with the exception of a "preamplifier coupled to each microphone in the microphone arrays," and with the exception of "digitizing the output." The Office Action then continues by suggesting that the use of preamplifiers and performing a digital frequency response analysis is disclosed by the ***Miller*** reference, with the combination of ***Heeden*** and ***Miller*** thus disclosing the claimed method. However, Appellants respectfully suggest that in making the aforementioned arguments, the Examiner has incorrectly characterized the claimed system.

For example, it should be noted that in describing the language of the Appellants' claimed system, the Examiner first states that "Heeden discloses a system ***for automatically matching <u>responses</u>*** in a microphone array…" (emphasis added). However, the language of the claimed system specifically recites a "system for ***automatically <u>matching preamplifiers</u> in a microphone array***." In claim 9, Appellants do not suggest or claim that any microphones in the microphone array are in any way used or addressed when matching the preamplifiers in that array. See for example FIG. 7, which shows the preamplifier pulse test circuit 720 ***tied directly to the input of the preamplifier*** 710 for injecting excitation pulses directly into the preamplifier.

On the other hand, ***Heeden*** discloses the adjustment of ***channel sensitivities*** of pressure transducing ***<u>microphones</u> over a range of frequencies*** for <u>matching an</u>

independently calibrated ***microphone*** to a second microphone (see, for example, the Abstract and column 4, lines 39-66 of the ***Heeden*** reference). In other words, ***Heeden*** requires that at least one microphone is first ***independently calibrated***. All other microphones are then matched to the independently calibrated microphone. Clearly, such teachings fail completely to disclose injection of "excitation pulses" directly into preamplifiers for the purpose of computing compensation gains to match each of the preamplifiers to each other ***regardless*** of microphone characteristics.

With respect to the ***Miller*** reference, the Examiner suggests that ***Miller*** teaches "…having preamplifiers (410, 411) coupled to each microphone…" The Examiner then continues by ***admitting*** that "the gains of the preamplifiers are adjusted to match the frequency responses ***between the microphones in the microphone array***." (emphasis added). Finally, the Examiner concludes in the rejection of claim 9 by suggesting that "…it would have been obvious… to modify Heeden in view of Miller by utilizing the adjustable preamplifier coupled to each microphone… in order to adjust the gain after frequency analysis." However, in contrast to the position advanced by the Examiner, Appellants respectfully suggest that the proposed ***Heeden*** – ***Miller*** combination reference fails to disclose the elements suggested by the Examiner.

For example, as clearly explained by the Examiner, ***Miller*** operates by adjusting "the gains of the preamplifiers… to match the frequency responses ***between the microphones in the microphone array***" (emphasis added). Appellants agree that ***Miller*** operates by adjusting "the gains of the preamplifiers… to match the frequency responses between the microphones in the microphone array." In fact, this process is clearly illustrated by FIG. 4 of the ***Miller*** reference which shows a transducer (203) producing a sound signal that is captured by two microphones (201 and 202) that each then send the captured sound to an associated preamplifier (410 and 411, respectively). As noted by the Examiner, ***Miller*** then adjusts the preamplifier gain to ***match the frequency response between the microphones***.

In other words, ***Heeden*** discloses the adjustment of ***channel sensitivities*** of pressure transducing ***microphones over a range of frequencies*** for matching an independently calibrated ***microphone*** to a second microphone, while ***Miller*** discloses adjusting preamplifier gains to ***match the frequency response between microphones***. Consequently, since both ***Heeden*** and ***Miller*** act separately to match microphone responses, Appellants respectfully suggest that the proposed ***Heeden-Miller*** combination reference must also act to ***match microphone responses based on inputs to those microphones***.

However, as noted above, Appellants neither describe nor claim matching ***channel sensitivities*** of pressure transducing ***microphones***. Further, Appellants neither describe nor claim matching ***the frequency response between microphones***. In fact, Appellants are not evaluating or matching the response of any microphones in the microphones array. Instead, Appellants are directly matching the response of preamplifiers based on a frequency-domain analysis of the measured preamplifier output response to synthetic excitation pulses that ***completely bypass the microphones***, and computing frequency-domain compensation gains for use in matching the output of the preamplifiers.

In other words, the proposed ***Heeden*** – ***Miller*** combination reference matches a ***microphone/preamplifier combination*** based on ***inputs to the microphones*** relative to an independently calibrated microphone while the claimed system operates to match ***preamplifiers*** using a synthetic excitation pulse injected directly into the preamplifiers independent from the microphones to which those preamplifiers are coupled.

Therefore, in stark contrast to the position advanced by the Examiner, it should be clear that the proposed ***Heeden*** – ***Miller*** combination reference fails completely to disclose the Appellants' claimed method. Consequently, with respect to claim 9, no prima facie case of obviousness has been established in accordance with both the M.P.E.P. Section 706.02(j), and in accordance with the holdings of *In Re Fine*. This lack of a prima facie showing of obviousness means that the rejected claims are

patentable under 35 U.S.C. §103(a). Therefore, the Appellants respectfully traverse the rejection of claim 9, and thus request reconsideration of the rejection of claim 9, and of the claims dependent therefrom, under 35 U.S.C. §103(a) over the proposed ***Heeden*** – ***Miller*** combination reference in view of the novel language of claim 9, as recited below:

> "A method for ***automatically matching preamplifier frequency-domain responses*** in a microphone array, comprising using a computing device to:
>
> generate at least one analog excitation pulse of a predetermined phase, magnitude and duration and provide the at least one generated analog ***excitation pulse to an input of each preamplifier*** in a microphone array;
>
> digitize an output resulting from each excitation pulse for each preamplifier in the microphone array;
>
> perform a ***frequency-domain analysis of the digitized output for each preamplifier*** in the microphone array; and
>
> compute ***frequency-domain compensation gains from the results of the frequency-domain analysis for matching the output of each preamplifier*** in the microphone array with each other." (emphasis added)

c. <u>Rejection of Claim 15 under 35 U.S.C. §103(a):</u>

In the Final Office Action dated December 11, 2007, independent claim 15 was rejected under 35 U.S.C. §103(a) as being unpatentable over ***Heeden*** (U.S. Patent 5,125,260) in view of ***Miller*** (U.S. Patent 5,029,215). In general, the Examiner rejected independent claim 15 under 35 U.S.C. §103(a) based on the rationale that the proposed ***Heeden*** – ***Miller*** combination reference discloses the Appellants' claimed system for "…automatically ***calibrating preamplifiers*** in a microphone array ***to provide matched preamplifier outputs*** …"

However, in view of the following discussion, Appellants' respectively suggest that independent claim 15 is patentably distinct from the cited references, and from any combination thereof, and therefore respectfully traverse the rejection of claim 15, and

the claims dependent therefrom, under 35 U.S.C. §103(a). Further, in view of the "***Response to Arguments***" presented on pages 4-6 of the final Office Action, the Appellants respectfully suggest that the Examiner has mischaracterized the claimed system and the purpose therefor.

For example, on page 6 of the Final Office Action, the Examiner specifically states:

> "The current invention as claimed ***does not simply match preamplifier as alleged*** in the argument (p. 12), the actual function is match output characteristic from the preamplifier coupled to a microphone… ***There is no point of matching the preamplifiers if they are not coupled to microphones***. It is clear based on the specification and the body of the claims that the current invention matching the output of a preamplifier coupled to a microphone with another preamplifier coupled to another microphone…" (emphasis added)

In making the above quoted statement, it appears to Appellants that the Examiner fails completely to understand the primary purpose of the claimed system. First, the claimed system ***does specifically match preamplifiers as alleged***. In particular, given a microphone array, the preamplifiers in that array can be closely matched ***without considering the microphones coupled to those preamplifiers by using synthetic excitation pulses injected directly into the preamplifiers***. This point is clearly described throughout the specification. Further, as described in further detail below, this point is fully supported by the figures and the claims. In addition, specific advantages of matching the preamplifiers without considering the microphones are explained in paragraphs [0016] and [0017] of the specification, as follows:

> "[0016] Once computed, these frequency-domain compensation gains can then be applied to the output of each corresponding preamplifier when processing actual audio inputs of the microphones associated with each preamplifier. ***This serves to make the output from each of the preamplifiers consistent, given***

> ***the same or similar input to any of the microphones in the array***. Consequently, using these computed frequency-domain compensation gains, audio processing software such as, for example, software for performing sound source localization, beam forming, acoustic echo cancellation, noise suppression, etc., can easily compensate for phase response mismatches across all preamplifiers. Without this compensation, any phase response mismatches would reduce the performance of the audio processing software."
>
> "[0017] Therefore, ***as a result of computing and providing these frequency-domain compensation gains for each preamplifier, there is no need to use expensive matched electrical components***. Consequently, one advantage offered by the integral self-calibration system described herein is that microphone arrays using this integral self-calibration system may be inexpensively produced by using relatively inexpensive non-matched electrical components including, for example, transistors, capacitors, resistors, op amps, etc."

As discussed in further detail below, both the ***Heeden*** and ***Miller*** references describe various techniques computing gains for the ***combination*** of a microphone and preamplifier based on preamplifier outputs resulting from ***inputs to the microphone that are then passed from the microphone to the preamplifier***.

Unfortunately, it appears that the Examiner has mistakenly equated the fact that the claimed preamplifiers are ***merely coupled to microphones*** in the microphone array with the fact that the preamplifiers in the both the ***Heeden*** and ***Miller*** references ***are a necessary and integral part*** of the gain compensation techniques described by ***Heeden*** and ***Miller*** for specifically matching <u>***microphone/preamplifier combinations***</u>.

In fact, in contrast to the teaching of both ***Heeden*** and ***Miller***, and as explained in the Appellants prior response, the claimed system does ***not*** use microphone inputs to compute compensation gains, and the claimed system does ***not*** use computed compensation gains to match microphone/preamplifier ***combinations***. In fact, as

discussed in further detail below, the Applicants specifically claim generating and injecting a synthetic "excitation pulse" directly into the preamplifiers, with the preamplifier output resulting from that synthetic "excitation pulse" being used to match the preamplifiers in the microphone array. Again, it must be noted that ***<u>microphone inputs are not a factor in determining the claimed compensation gains</u>***, and that the claimed system is ***not*** intended to match microphone/preamplifier ***combinations*** as is taught by both ***Heeden*** and ***Miller***.

In other words, while both ***Heeden*** and ***Miller*** specifically ***require microphone inputs*** that are then provided to the preamplifier, Appellants specifically describe and claim a synthetic "excitation pulse" that is injected directly into the preamplifiers (thus inherently ***bypassing*** the microphones coupled to those preamplifiers). As such, the proposed ***Heeden*** – ***Miller*** combination reference fails to disclose the claimed system.

In particular, in the Final Office Action, the Examiner suggested that the ***Heeden*** reference discloses the claimed system with the exception of a "preamplifier coupled to each microphone in the microphone arrays," and with the exception of "digitizing the output." The Office Action then continues by suggesting that the use of preamplifiers and performing a digital frequency response analysis is disclosed by the ***Miller*** reference, with the combination of ***Heeden*** and ***Miller*** thus disclosing the claimed system. However, Appellants respectfully suggest that in making the aforementioned arguments, the Examiner has incorrectly characterized the claimed system.

For example, it should be noted that in describing the language of the Appellants' claimed system, the Examiner first states that "Heeden discloses a system ***for automatically matching <u>responses</u>*** in a microphone array…" (emphasis added). However, the language of the claimed system specifically recites a "system for ***automatically <u>matching preamplifiers</u> in a microphone array***." In claim 15, Appellants do not suggest or claim that any microphones in the microphone array are in any way used or addressed when matching the preamplifiers in that array. See for example FIG. 7, which shows the preamplifier pulse test circuit 720 ***tied directly to the***

input of the preamplifier 710 for injecting excitation pulses directly into the preamplifier.

On the other hand, ***Heeden*** discloses the adjustment of ***channel sensitivities*** of pressure transducing ***<u>microphones</u> over a range of frequencies*** for <u>matching an independently calibrated ***microphone*** to a second microphone</u> (see, for example, the Abstract and column 4, lines 39-66 of the ***Heeden*** reference). In other words, ***Heeden*** requires that at least one microphone is first ***independently calibrated***. All other microphones are then matched to the independently calibrated microphone. Clearly, such teachings fail completely to disclose injection of "excitation pulses" directly into preamplifiers for the purpose of computing compensation gains to match each of the preamplifiers to each other ***regardless*** of microphone characteristics.

With respect to the ***Miller*** reference, the Examiner suggests that ***Miller*** teaches "…having preamplifiers (410, 411) coupled to each microphone…" The Examiner then continues by ***admitting*** that "the gains of the preamplifiers are adjusted to match the frequency responses ***<u>between the microphones in the microphone array</u>***." (emphasis added). Finally, the Examiner concludes in the rejection of claim 15 by suggesting that "…it would have been obvious… to modify Heeden in view of Miller by utilizing the adjustable preamplifier coupled to each microphone… in order to adjust the gain after frequency analysis." However, in contrast to the position advanced by the Examiner, Appellants respectfully suggest that the proposed ***Heeden*** – ***Miller*** combination reference fails to disclose the elements suggested by the Examiner.

For example, as clearly explained by the Examiner, ***Miller*** operates by adjusting "the gains of the preamplifiers… to match the frequency responses ***<u>between the microphones in the microphone array</u>***" (emphasis added). Appellants agree that ***Miller*** operates by adjusting "the gains of the preamplifiers… to match the frequency responses between the microphones in the microphone array." In fact, this process is clearly illustrated by FIG. 4 of the ***Miller*** reference which shows a transducer (203) producing a sound signal that is captured by two microphones (201 and 202) that each

then send the captured sound to an associated preamplifier (410 and 411, respectively). As noted by the Examiner, ***Miller*** then adjusts the preamplifier gain to ***match the frequency response between the microphones***.

In other words, ***Heeden*** discloses the adjustment of ***channel sensitivities*** of pressure transducing ***microphones*** ***over a range of frequencies*** for matching an independently calibrated ***microphone*** to a second microphone, while ***Miller*** discloses adjusting preamplifier gains to ***match the frequency response between microphones***. Consequently, since both ***Heeden*** and ***Miller*** act separately to match microphone responses, Appellants respectfully suggest that the proposed ***Heeden-Miller*** combination reference must also act to ***match microphone responses based on inputs to those microphones***.

However, as noted above, Appellants neither describe nor claim matching ***channel sensitivities*** of pressure transducing ***microphones***. Further, Appellants neither describe nor claim matching ***the frequency response between microphones***. In fact, Appellants are not evaluating or matching the response of any microphones in the microphones array. Instead, Appellants are directly matching the response of preamplifiers based on a frequency-domain analysis of the measured preamplifier output response to synthetic excitation pulses that ***completely bypass the microphones***, and computing frequency-domain compensation gains for use in matching the output of the preamplifiers.

In other words, the proposed ***Heeden*** – ***Miller*** combination reference matches a ***microphone/preamplifier combination*** based on ***inputs to the microphones*** relative to an independently calibrated microphone while the claimed system operates to match ***preamplifiers*** using a synthetic excitation pulse injected directly into the preamplifiers independent from the microphones to which those preamplifiers are coupled.

Further, it must also be noted that in the Final Office Action, the Examiner ***failed to address the elements of claim 15*** relating to the use of a "***switchable pulse***

generation circuit " included in the microphone array. In particular, as claimed, the microphone array specifically includes a ***switchable pulse generation circuit*** for generating excitation pulses of a predetermined duration, magnitude and phase. Further, in the Final Office Action, the Examiner also ***<u>failed to address the element of claim 15</u>*** relating to "***remotely initiating generation of at least one excitation pulse in the switchable pulse generation circuit*** from a remote computing device coupled to the microphone array via a computer interface." As such, the claimed system includes at least two elements not addressed in any way by the Examiner. Appellants respectfully suggest that these elements are not disclosed in either the ***Heeden*** or ***Miller*** references, or in any possible combination thereof.

Further, these claimed elements are fully supported by both the specification and drawings. For example, as illustrated by FIG. 7, an output of a "switchable pulse generation circuit" (see the preamplifier pulse test circuit (720)) is tied to an input of each preamplifier. This switchable pulse generation circuit is triggered by "remotely initiating generation of at least one excitation pulse in the switchable pulse generation circuit from a remote computing device coupled to the microphone array via a computer interface." Specifically, as discussed in paragraph [0113], an input at point A (750) is used to trigger the claimed switchable pulse generation circuit to generate the excitation pulse. As noted above, the output of the pulse generation circuit 720 is tied to an input of each preamplifier 710. Consequently, when the pulse generation circuit 720 generates the excitation pulse, the claimed system automatically injects "***each excitation pulses into each preamplifier***."

Therefore, in stark contrast to the position advanced by the Examiner, it should be clear that the proposed ***Heeden*** – ***Miller*** combination reference fails completely to disclose the Appellants' claimed system. Consequently, with respect to claim 15, no prima facie case of obviousness has been established in accordance with both the M.P.E.P. Section 706.02(j), and in accordance with the holdings of *In Re Fine*. This lack of a prima facie showing of obviousness means that the rejected claims are patentable under 35 U.S.C. §103(a). Therefore, the Appellants respectfully traverse the

rejection of claim 15, and thus request reconsideration of the rejection of claim 15, and of the claims dependent therefrom, under 35 U.S.C. §103(a) over the proposed ***Heeden – Miller*** combination reference in view of the novel language of claim 15, as recited below:

> "A system for automatically ***calibrating preamplifiers in a microphone array to provide matched preamplifier outputs***, comprising:
>
> a microphone array including at least one microphone, each microphone further including at least one preamplifier;
>
> said microphone array further including a ***switchable pulse generation circuit*** for generating excitation pulses of a predetermined duration, magnitude and phase;
>
> ***remotely initiating generation of at least one excitation pulse in the switchable pulse generation circuit*** from a remote computing device coupled to the microphone array via a computer interface;
>
> automatically injecting ***each excitation pulses into each preamplifier***;
>
> ***measuring an output resulting from each injected excitation pulse for each preamplifier***;
>
> ***providing the measured output for each preamplifier to the remote computing device*** via the computer interface;
>
> on the remote computing device, performing a frequency-domain analysis of the measured output for each preamplifier; and
>
> ***computing frequency-domain compensation gains from the results of the frequency-domain analysis for matching the output of each preamplifier*** in the microphone array with each other." (emphasis added)

VIII. CLAIMS APPENDIX

The claims listed below provide a complete copy of all claims involved in the Appeal:

Listing of Claims:

1 (Original). A system for automatically matching preamplifiers in a microphone array, comprising:

injecting at least one excitation pulse into each preamplifier in the microphone array;

measuring each preamplifier output response to each excitation pulse;

performing a frequency-domain analysis of the measured preamplifier output response to each excitation pulse; and

computing frequency-domain compensation gains from the results of the frequency-domain analysis for matching the output of each preamplifier.

2 (Original). The system of claim 1 wherein two or more excitation pulses are injected into each preamplifier in the microphone array, and wherein the measured preamplifier output response for each preamplifier is the average response to each excitation pulse.

3 (Original). The system of claim 1 wherein the microphone array further comprises a computer interface for connecting the array to an external computing device.

4 (Previously Presented). The system of claim 3 wherein the at least one excitation pulse is automatically generated by the microphone array in response to a pulse generation command from the external computing device via the computer interface.

5 (Original). The system of claim 3 wherein the microphone array further comprises an integral memory for maintaining a set of parameters defining operational characteristics of the microphone array.

6 (Original). The system of claim 5 wherein the set of parameters defining operational characteristics of the microphone array is automatically reported to the external computing device via the computer interface.

7 (Original). The system of claim 6 wherein the set of parameters defining operational characteristics of the microphone array includes information defining the computed frequency-domain compensation gains for each preamplifier in the array.

8 (Original). The system of claim 3 wherein the computer interface for connecting the array to the external computing device is any of a wired and a wireless computer interface.

9 (Original). A method for automatically matching preamplifier frequency-domain responses in a microphone array, comprising using a computing device to:

generate at least one analog excitation pulse of a predetermined phase, magnitude and duration and provide the at least one generated analog excitation pulse to an input of each preamplifier in a microphone array;

digitize an output resulting from each excitation pulse for each preamplifier in the microphone array;

perform a frequency-domain analysis of the digitized output for each preamplifier in the microphone array; and

compute frequency-domain compensation gains from the results of the frequency-domain analysis for matching the output of each preamplifier in the microphone array with each other.

10 (Previously Presented). The method of claim 9 wherein for each analog excitation pulse provided to the input of each preamplifier in a microphone array, the

resulting digitized outputs are averaged, and wherein the averaged digitized output for each preamplifier is used to perform the frequency-domain analysis and to compute the frequency-domain compensation gains from the results of the frequency-domain analysis.

11 (Original). The method of claim 9 wherein the computed frequency-domain compensation gains are used to automatically configure audio processing software operating within an external computing device to reflect a current configuration of the microphone array, said microphone array being coupled to the external computing device via any of a wired and a wireless computer interface.

12 (Original). The method of claim 9 wherein the computed frequency-domain compensation gains are stored locally within the microphone array within a microphone array memory.

13 (Original). The method of claim 12 wherein the microphone array memory further includes information defining microphone types and geometry for each microphone in the microphone array, and a microphone array working volume for each microphone in the microphone array.

14 (Original). The method of claim 12 wherein the microphone array memory is a programmable memory, and wherein the information stored within the programmable memory in an addressable lookup table.

15 (Original). A system for automatically calibrating preamplifiers in a microphone array to provide matched preamplifier outputs, comprising:

a microphone array including at least one microphone, each microphone further including at least one preamplifier;

said microphone array further including a switchable pulse generation circuit for generating excitation pulses of a predetermined duration, magnitude and phase;

remotely initiating generation of at least one excitation pulse in the switchable pulse generation circuit from a remote computing device coupled to the microphone array via a computer interface;

automatically injecting each excitation pulses into each preamplifier;

measuring an output resulting from each injected excitation pulse for each preamplifier;

providing the measured output for each preamplifier to the remote computing device via the computer interface;

on the remote computing device, performing a frequency-domain analysis of the measured output for each preamplifier; and

computing frequency-domain compensation gains from the results of the frequency-domain analysis for matching the output of each preamplifier in the microphone array with each other.

16 (Original). The system of claim 15 wherein the measured output for each preamplifier is averaged with each other measured output for each individual preamplifier, and wherein the averaged output for each preamplifier is provided as the measured output for each preamplifier to the remote computing device via the computer interface.

17 (Previously Presented). The system of claim 15 wherein the microphone array further includes at least one addressable memory for storing operational parameters of the microphone array; and

wherein the microphone array automatically reads the parametric information from the addressable memory and reports the parametric information to the remote computing device via a computer interface, said remote computing device being remotely coupled to the microphone array via the computer interface.

18 (Original). The system of claim 15 wherein the microphone array further includes a set of at least one speaker for reproducing one or more audio signals.

19 (Original). The system of claim 15 wherein the computer interface is any of a wired and a wireless computer interface.

20 (Previously Presented). The system of claim 15 further comprising automatically configuring audio processing software operating within the remote computing device to reflect the computed frequency-domain compensation gains for each preamplifier in the microphone array when processing audio signals being provided to the external computing device from the microphone array via the computer interface.

IX. <u>EVIDENCE APPENDIX</u>

None

X. <u>RELATED PROCEEDINGS APPENDIX</u>

None

Respectfully submitted,

Mark Watson

Mark A. Watson
Registration No. 41,370
Attorney for Appellants

Lyon & Harr
300 Esplanade Drive, Suite 800
Oxnard, California 93036
(805) 278-8855